

Progress with the room temperature structures for the RIA facility

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(paper 2.1.4)

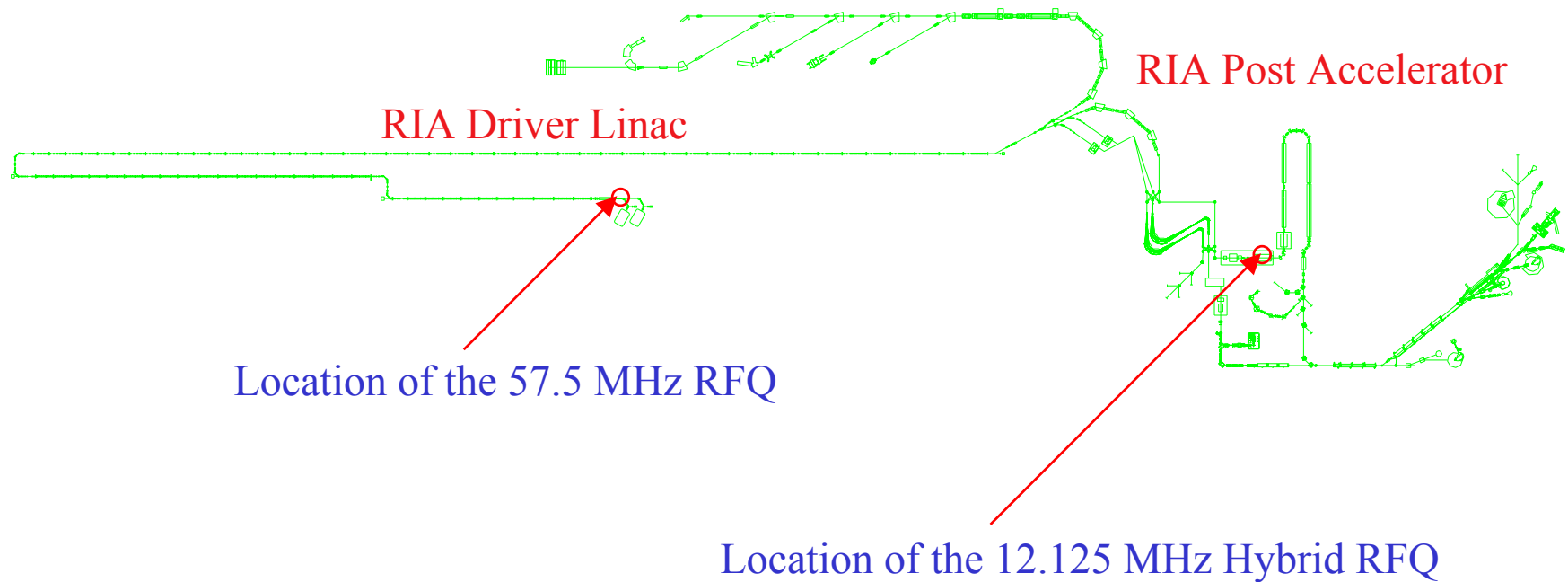
RIA R&D Workshop, August 26-28, 2003

Argonne National Laboratory
Operated by The University of Chicago
for the U.S. Department of Energy



- 57.5 MHz RFQ for the RIA Driver linac.
 - Construction of the prototype
 - Computer simulations
 - Experimental results.
- 12.125 MHz Hybrid RFQ for the RIA Post-Accelerator.
 - Construction of the prototype
 - Final modifications of the model
 - Experimental results
- Summary and needs for future work

57.5 RFQ and 12.125 MHz H-RFQ location in the RIA



The cold models are necessary to determine

- **the final cavity dimensions prior to fabrication of full-power prototypes**
- **accelerating and focusing fields distribution**
- **electrodynamics parameters**
- **coupling to the external power supply**

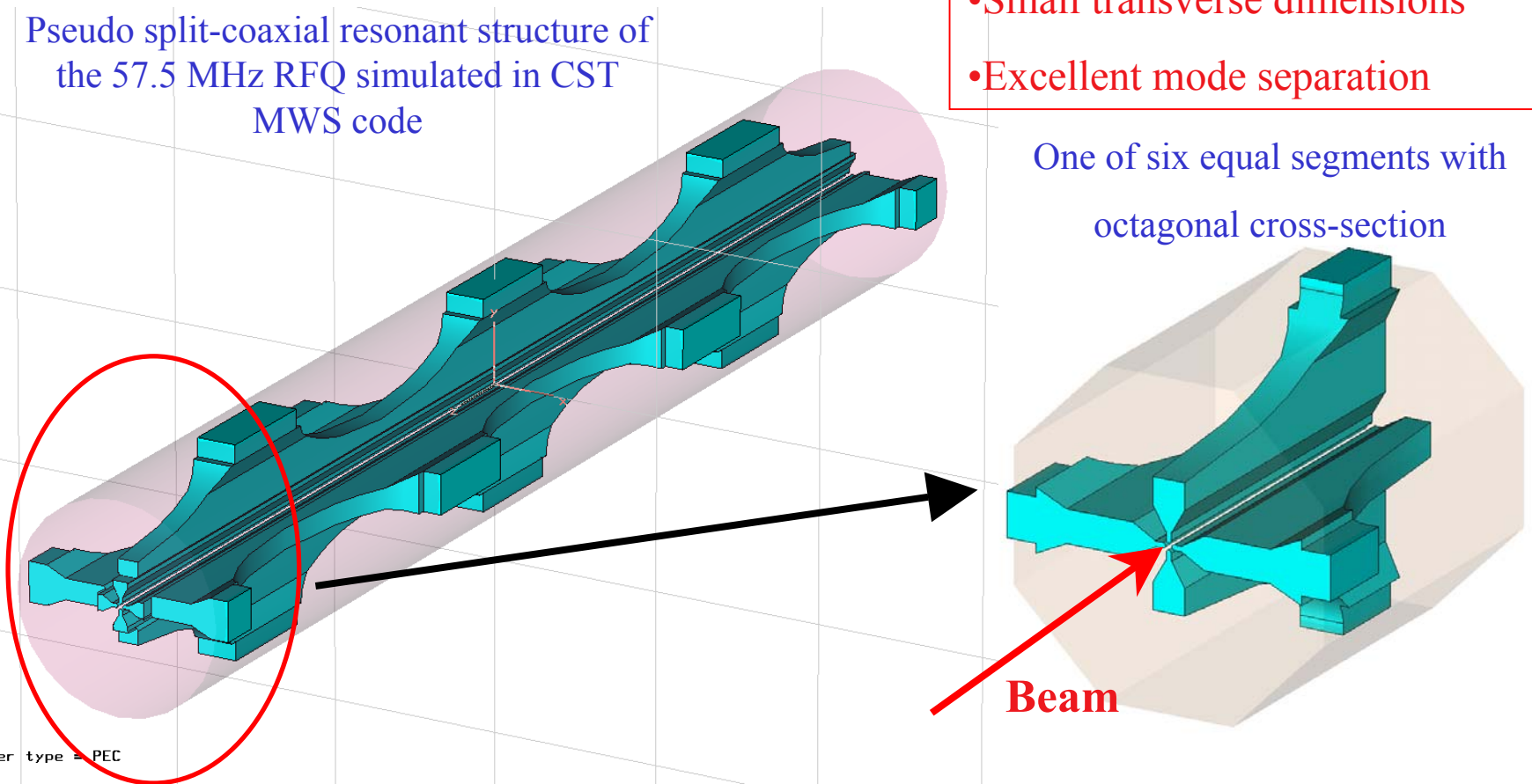
57.5 MHz RFQ resonant structure

Design features:

- CW regime
- High shunt impedance
- Small transverse dimensions
- Excellent mode separation

Pseudo split-coaxial resonant structure of
the 57.5 MHz RFQ simulated in CST
MWS code

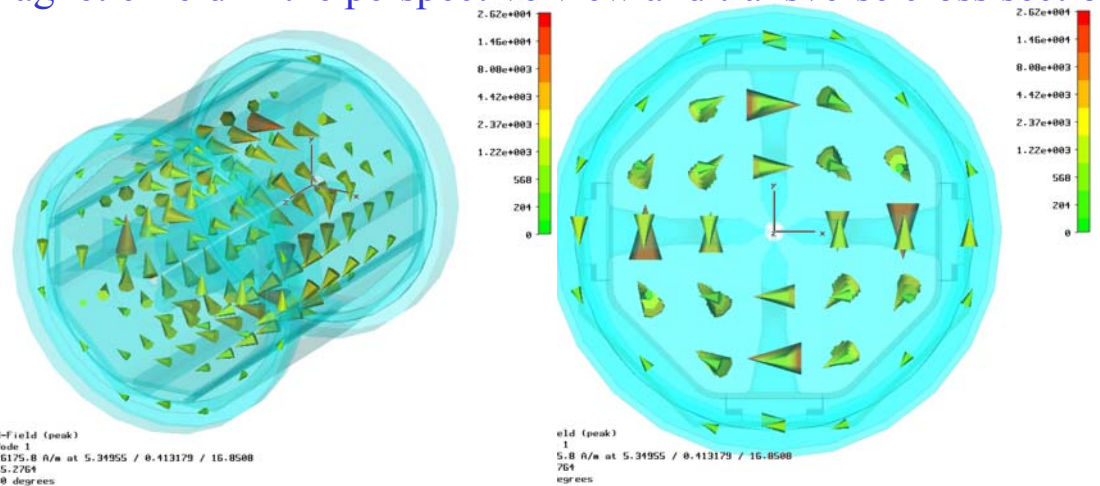
One of six equal segments with
octagonal cross-section



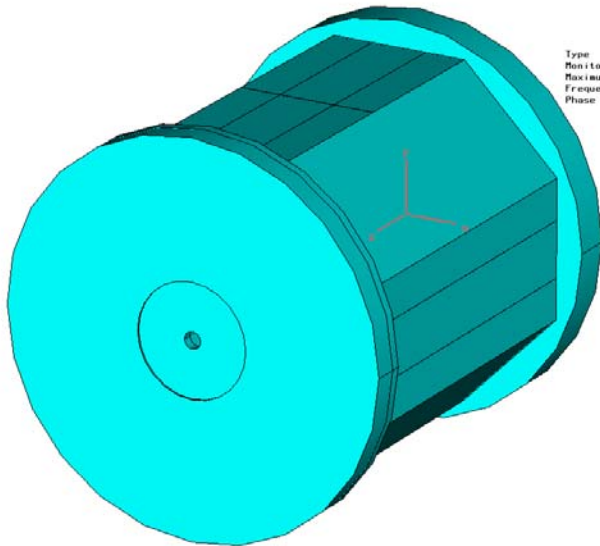
Computer simulations

Magnetic field in the perspective view and transverse cross section

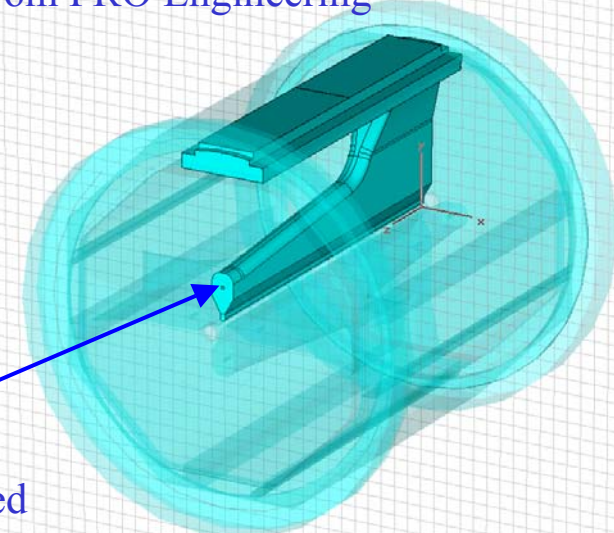
RFQ segment in the MWS model



The transparent sketch of MWS model with geometry imported from PRO Engineering



Type = H-field (peak)
Monitor = Mode 1
Maximum-3d = 26175.8 A/m at 5.34955 / 0.413179 / 16.8588
Frequency = 55.2754
Phase = 90 degrees

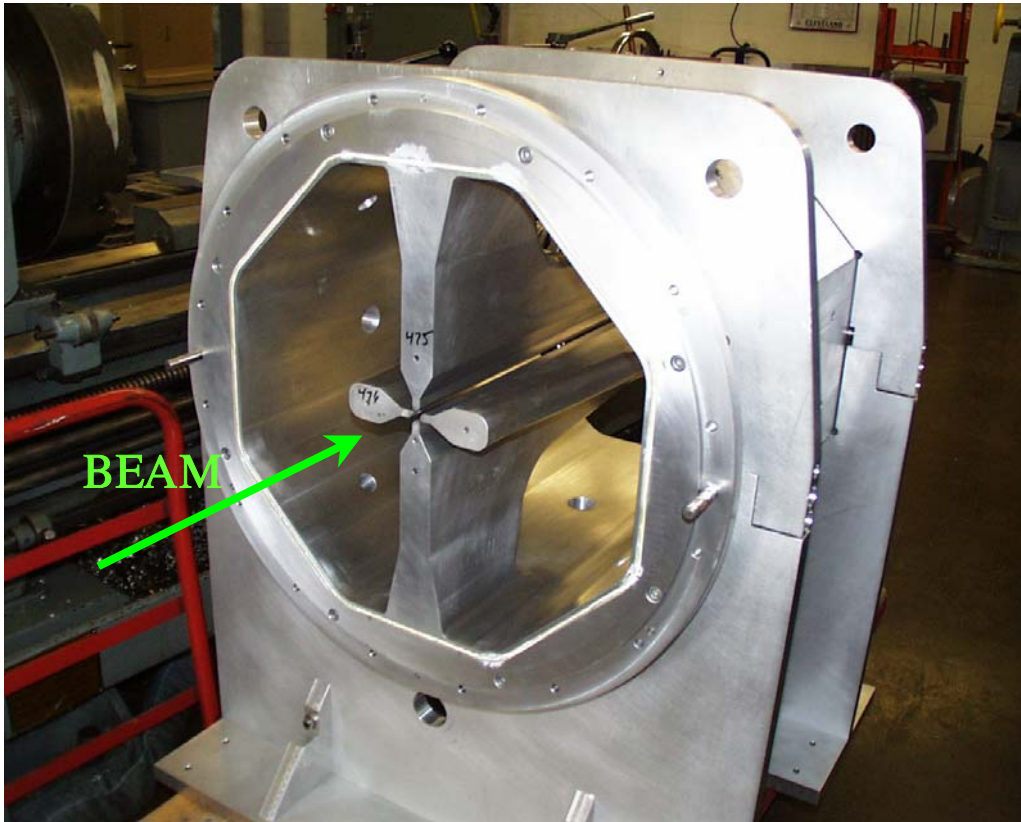


One of the vanes is highlighted

57.5 MHz RFQ for the RIA Driver linac

View on the structure details inside the cavity

The aluminum cold model assembly with opened end plates



The vane made out of OFE copper and brazed with 50-50 Cu-Au alloy at ANL central shop



Experimental results

Frequency spectrum of the prototype

Mode	Calculated frequency, MHz	Measured frequency, MHz
1	55.276	54.469
2	93.658	93.103
3	94.321	93.704
4	194.699	195.937
5	232.809	248.725

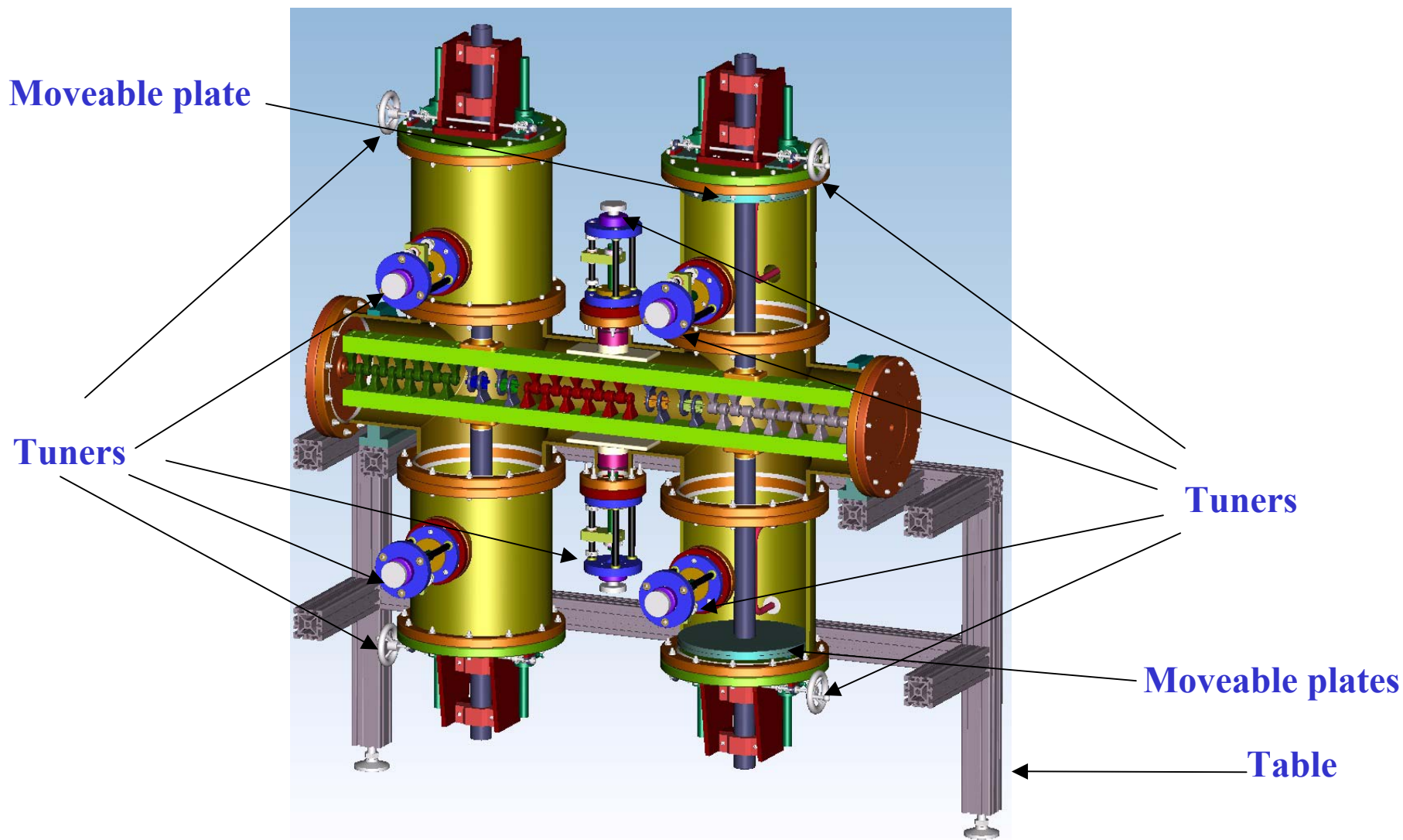
Quality factor of the aluminum model

Simulations: $Q_0^{\text{sim}} = 6500$

Experiment: $Q_0^{\text{exp}} = 4984$

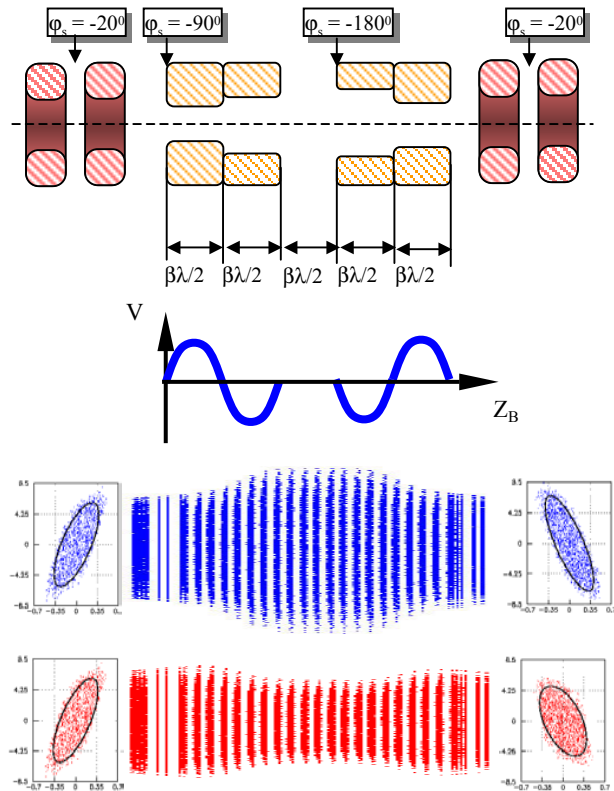
$$Q_0^{\text{exp}} = 77\% Q_0^{\text{sim}}$$

12.125 MHz Hybrid RFQ for the RIA Post-Accelerator

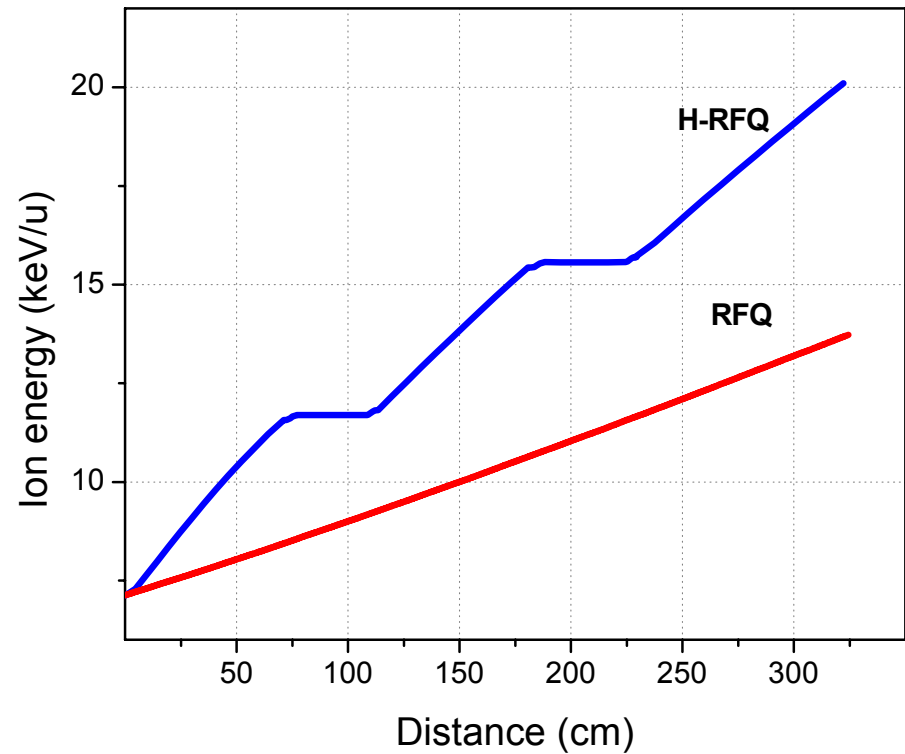


Principle of the Hybrid RFQ operation

Beam focusing in the RFQ sections

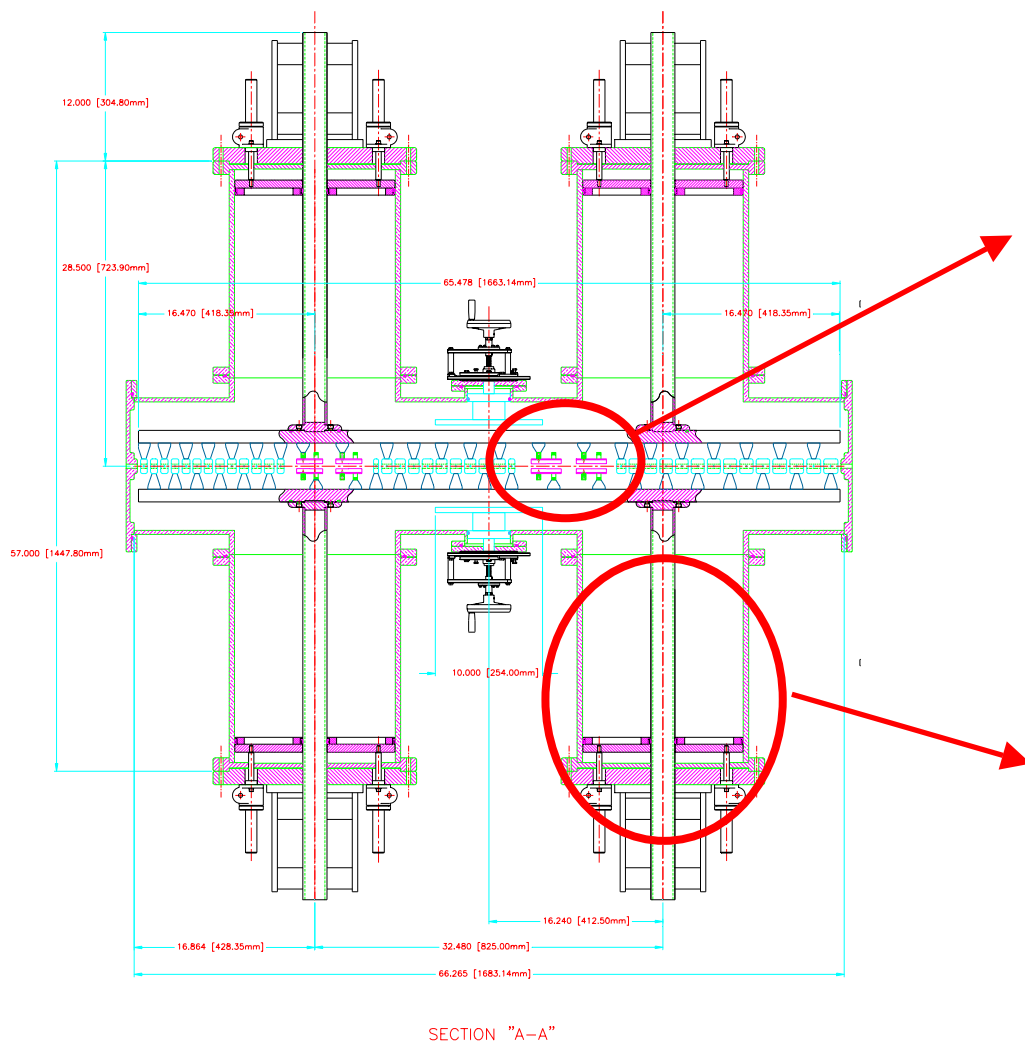


Energy gain in the H-RFQ and in conventional RFQ

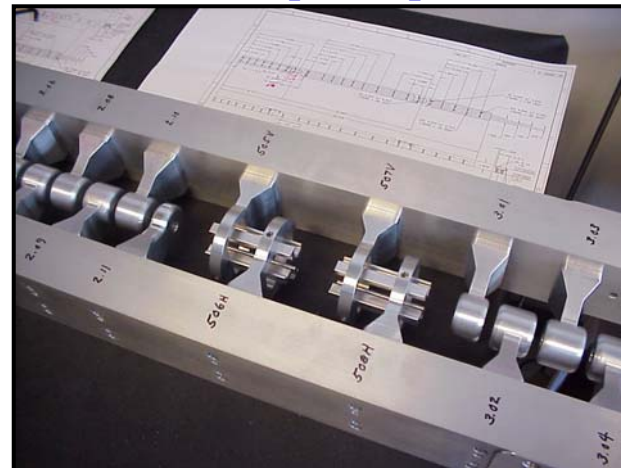


12.125 MHz Hybrid RFQ prototype

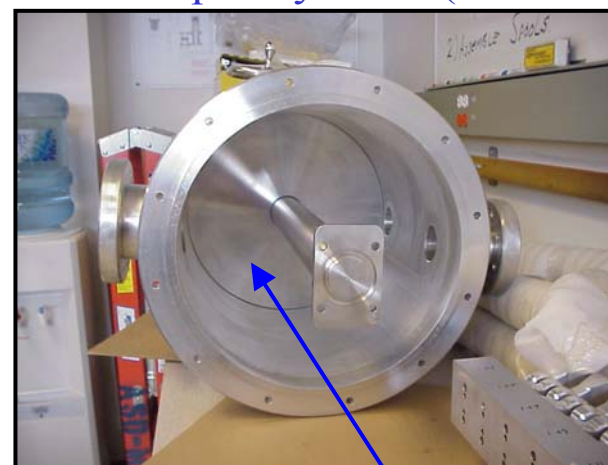
Assembly drawings and computer model of the H-RFQ prototype



Drift tubes and quadrupoles sections



The frequency tuner (inside view)



Moveable plate

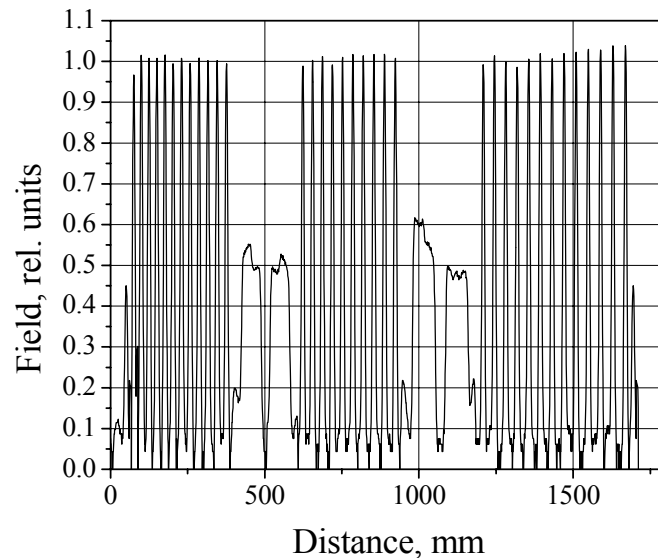
Design modifications

Electrodynamics parameters of the H-RFQ cold model

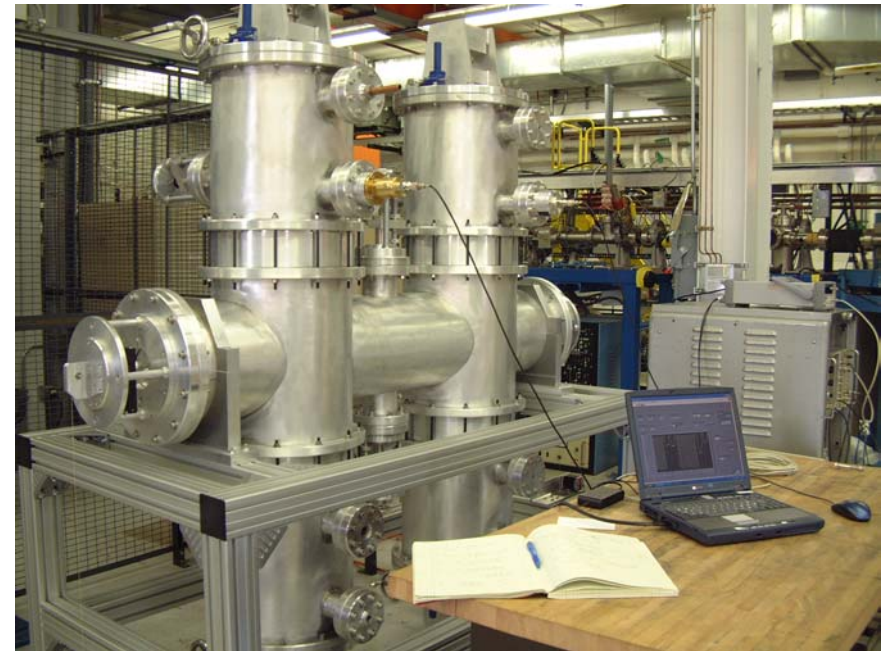
	MWS simulation	Measurement before the modification	Measurement after the modification
Q	4700	1350-2300	3150
f (MHz)	24.65	26.5	24.25

$$\frac{R_s}{Q_0} = 6.85 \cdot 10^4 \Omega \quad \frac{R_s}{Q_0} (MWS) = 7.11 \cdot 10^4 \Omega$$

Field distribution along the H-RFQ



Aluminum cold model of the H-RFQ after the modification



- Cold models of two accelerating structures for the RIA were built and investigated
- The measured electrodynamics parameters of the models will be used for construction of full-power prototypes

Needs for the future work

1. Build full-power one-segment prototype of the 57.5 MHz RFQ for the RIA Driver Linac to demonstrate
 - **Fabrication technology**
 - **Operation in wide range of rf power without multipacting**
 - **Acceleration of two charge state heavy-ion beams**

2. Build full-scale full-power prototype of the 12.125 MHz Hybrid RFQ for the RIA Post-Accelerator to demonstrate
 - **Fabrication technology**
 - **Operation in wide range of rf power without multipacting**
 - **Acceleration of single charged uranium beams**